Upper Salmon River Subbasin Assessment and TMDL

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IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY
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UPPER SALMON RIVER SUBBASIN ASSESSMENT AND TOTAL MAXIMUM DAILY LOAD

EXECUTIVE SUMMARY

Water quality, native fish populations and riparian habitat conditions have been issues of concern in the Upper Salmon River Subbasin. The cumulative effects of mining, warm season grazing, grazing over-utilization of riparian areas, timber harvest and associated roads, introduction of exotic fish and plant species, residential and recreational development, and human-caused stream alteration and diversion of surface waters have combined to limit the production and survival of native resident and anadromous fishes throughout the subbasin. There are numerous restoration projects that have been completed, are under construction, or are planned in the Upper Salmon River Subbasin to offset historic management and land use as well. These projects have resulted in dramatic improvement in water quality and fisheries of many miles of streams in the Upper Salmon River Subbasin. The waters of the Upper Salmon River have been identified as an essential component of anadramous fish, and bull trout restoration in Idaho. This Subbasin Assessment and Total Maximum Daily Load (TMDL) is intended to identify where improvements in water quality are needed, and possible, to support the intent of the federal Clean Water Act that waters of the United States be fishable and swimable.

The Clean Water Act requires that the state of Idaho identify water quality limited surface waters and develop a plan to restore beneficial use support to these waters. The Endangered Species Act requires that conservation plans be developed and implemented to restore anadromous fish and bull trout populations to levels that insure their persistence in the Upper Salmon River Watershed.

The Idaho Department of Environmental Quality (DEQ) has identified that Challis Creek is not fully supporting the beneficial uses of salmonid spawning and coldwater biota as defined in state Water Quality Standards and the federal Clean Water Act. A Total Maximum Daily Load for sediment has been prepared for this water to restore full support of these beneficial uses.

To the extent practical and possible the Challis Creek Total Maximum Daily Load, in addition to restoring beneficial uses on the water quality limited reach, will assist any conservation plan for endangered species recovery. This will be done by improving water quality and habitat conditions through the implementation of best management practices identified by the Idaho Soil Conservation Commission; the designated management agency for implementation of agriculture related best management practices.

The beneficial use support status of other waters in the subbasin are described and categorized within this document to initiate tracking of their support status in relation to land use management needs and existing implementation projects.

Assessments by DEQ have identified that water quality has been limited by deposition of sediment in the stream channel of Challis Creek due to streambank and road erosion and historic mass wasting. Previous assessments by the Bureau of Land Management, the USDA Forest Service, and the State Soil Conservation Commission have also identified similar sources of pollutants and the problems associated with water quality in the Challis Creek watershed. A TMDL has been prepared for Challis Creek within this document.

Recent improvement in land management practices have created the potential for improving water quality, fish habitat conditions, fish passage, spawning success and connectivity within the subbasin including Challis Creek, its tributaries, and the Salmon River. Water quality and habitat conditions have shown improvement where best management practices have been implemented and natural conditions have been given an opportunity to improve. It is expected that with continued riparian management beneficial uses will be restored in Challis Creek.

It is not likely, however, that beneficial uses will be restored in streams of the watershed where dewatering from surface water diversion occurs during significant periods of the year. The potential exists, however, for voluntary and cooperative management agreements that improve flow conditions without negatively impacting the rural economy of the subbasin. The natural and social conditions within the watershed play an important role when attempting to identify the reduction of pollutant loads necessary for beneficial use restoration while maintaining the viability of the local economy and quality of life for residents in the subbasin.

DEQ has developed recommendations for the reduction of sediment from streambank erosion, mass wasting and road erosion within the Challis Creek watershed that would ultimately likely result in beneficial use support through improving streambank stability, reducing road erosion and stabilizing mass wasting, ultimately improving riparian vegetation. Sediment loads are quantified through stream bank erosion inventories that estimate streambank erosion based on streambank conditions observed and documented along 4 reaches of Challis Creek. Road erosion was quantified along two reaches that were combined.

Instream sediment targets have been identified from literature values that are supportive of salmonid spawning and coldwater biota. These target values are set at less than 28% fine sediment less than 6.35mm (1/4 in.) diameter in spawning habitat and will be used to track the progress of streambank stabilization, and associated reduction of depth fines to determine the need for additional management practices to improve water quality on Challis Creek.

The recommended load allocation within this TMDL is an overall reduction of 34% in sediment from streambank, mass wasting and road erosion into Challis Creek. The Table below summarizes the prescribed sediment reductions for Challis Creek. This reduction of sediment from erosion in Challis Creek should result in a reduction of streambed fine sediment (sediment smaller than 6.35 mm (0.25 in)) to the target level of 28%, or less, to a depth of 4 inches in spawning habitat. These reductions incorporate an implicit margin of safety (MOS) to assure restoration of beneficial uses. The identified MOS equates to streambank erosion rates expected from streambanks that exhibit 80% or greater streambank stability, which is considered natural background erosion within this TMDL. Monitoring will be conducted by land management agencies to determine the adequacy of reductions and management practices.

Challis Creek Sediment Loading Summary

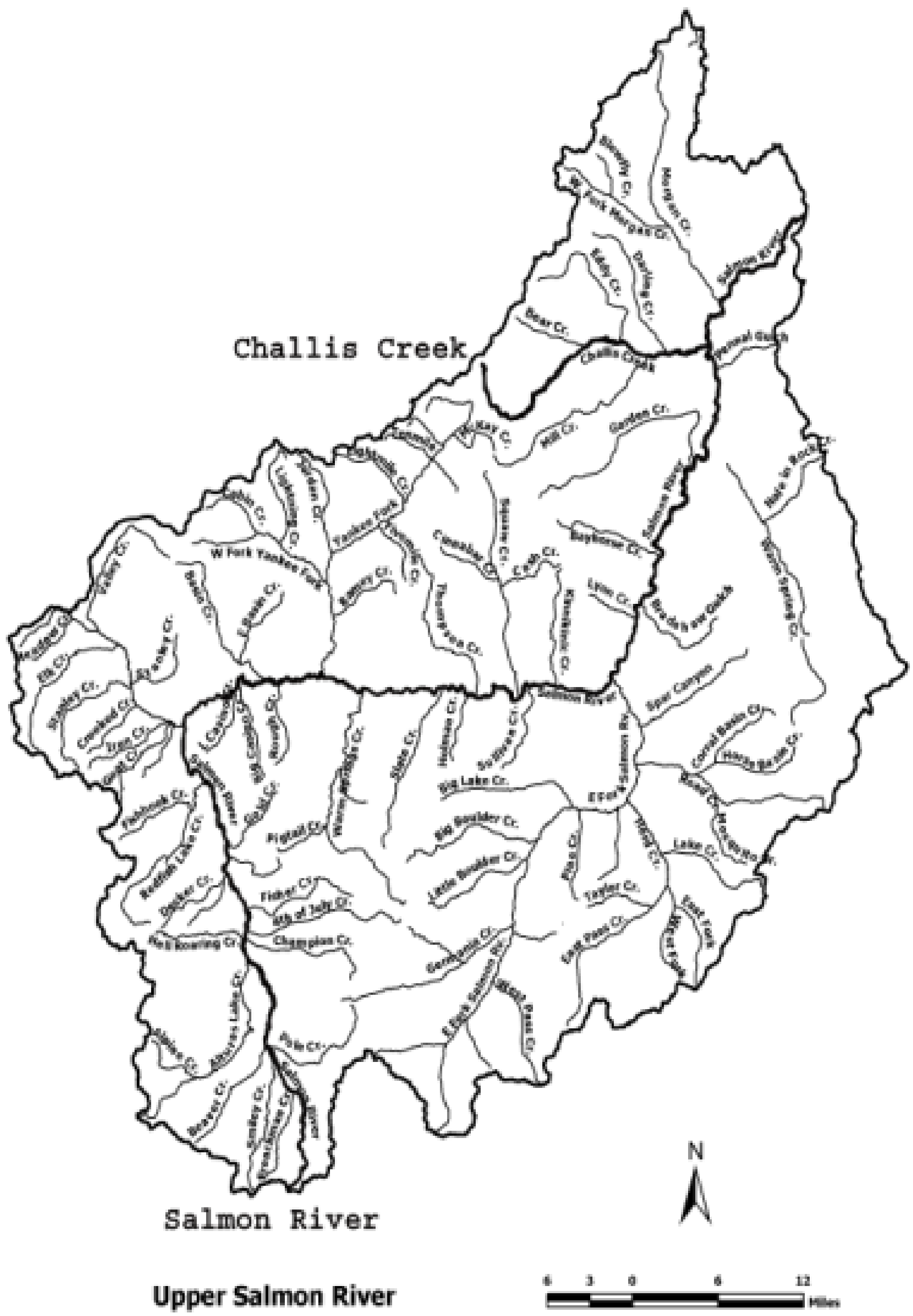
Reach Number (from downstream to upstream)	Existing Erosion Rate (t/mi/y)	Total Erosion Rate (t/y)	Proposed Erosion Rate (t/mi/y)	Load Allocations (t/y)	Erosion Rate Percent Reduction	Percent of Total Erosion
Landslide	N/A	195	N/A	146	25	19
Upper	71	318	36	159	49	31
3 (Upper Middle)	10	46	6	28.5	40	5
2 (Middle)	5	6	6	8	0	<1
1 (Lower)	96	422	71	313	26	42
5 Road	9	24	5	14	44	2
Totals	----------	**1011**	----------	**668**	**34**	**100**

There are 11 §303(d) listed stream/river segments on 9 waters in the Upper Salmon River Subbasin. There is one TMDL for Challis Creek prepared in this document. The disposition of the remaining §303(d) listed streams that will not have a TMDL prepared for pollutant loads is based on guidance provided by the Environmental Protection Agency in a memorandum from November 2001 titled 2002 Integrated Water Quality Monitoring and Assessment Report Guidance.

Streams already having implementation of best management practices that should result in attainment of water quality standards and beneficial use support in the near future do not require TMDLs as described in section 4b of the memorandum. Streams that fall into this category are Thompson Creek and Kinnikinic Creek. The listed reaches of the Salmon River do not require TMDLs because they fully support beneficial uses.

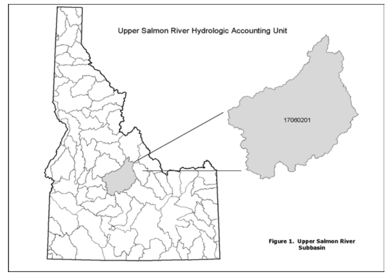
Streams that have flow less than 1 cfs are not used to represent segments with higher flow, and are not held to narrative water quality standards. Numeric water quality standards do apply during periods of optimal flow, however. Lost Creek in the upper Stanley Basin is such a creek. It was listed in error and will not have a TMDL developed for it.

Streams that are frequently dewatered for significant periods of the year, or throughout the year do not have a reasonable potential to support beneficial uses of cold water biota or salmonid spawning. Flow, in and of itself, is not considered a pollutant, however a listing category of flow alteration exists for these streams. The same is true for habitat alteration. Anthropogenic causes of flow alteration in the Upper Salmon River Subbasin are diversion for irrigation and stock watering, aquaculture and hydroelectric power generation. Road Creek, from the lower private/BLM boundary downstream, and Warm Spring Creek from the hatchery diversion downstream falls into the category of flow alteration. Garden Creek from the upstream Challis City Limit to the confluence with the Salmon River will be listed for flow and habitat alteration. The Yankee Fork of the Salmon River will be listed for habitat alteration from 4th of July Creek to the Salmon River. A TMDL will not be developed for them. In the event that voluntary and cooperative water conservation projects are developed and implemented these streams will be re-evaluated.



Upper Salmon River Subbasin Major Streams.

Total Maximum Daily Load (TMDL) Upper Salmon River Watershed
Hydrologic Unit Code 17060201



Water Quality Limited Segment (Assessment Units)	Stream Name	303(d) Listed *Reach*	*Miles*	Pollutant	Subbasin Assessment Recommendation
3009 (17060201SL019_04 17060201SL027_05 17060201SL031_05 17060201SL047_05)	**Salmon River**	**Redfish Lake Creek to E.F. Salmon River**	**44.45**	**Sediment and Temperature**	**No TMDL; Beneficial Uses Fully Supported**
3010 (17060201SL068_05 17060201SL072_05 17060201SL073_05)	**Salmon River**	**Hellroaring Creek to Redfish Lake Creek**	**13.34**	Sediment	**No TMDL; Beneficial Uses Fully Supported**
3013 (17060201SL09_03 17060201SL07_04)	**Challis Creek**		**9.35**	**Sediment; Nutrients and Flow Alteration**	**Sediment TMDL: 34% Reduction; remove other listings**
3017 (17060201SL015_03 17060201SL015_02 17060201SL015_04)	**Garden Creek**	**Forest Boundary to Salmon River**	**14.40**	**Sediment and Nutrients**	**Remove Listings for Sediment and Nutrients; source of Impairment is Flow Alteration**
3019 (17060201SL131_04 17060201SL133_02 17060201SL132_04)	**Warm Springs Creek**	**Headwaters to Sink**	**13.85**	**Sediment and Nutrients**	**Remove Listings for Sediment and Nutrients; source of Impairment is Flow Alteration**
3031 (17060201Sl028_03)	**Thompson Creek**	**Scheelite Jim Mill to Salmon River**	**1.02**	**Sediment, Habitat Alteration**	**No TMDL, Relist in § 4b, all BMPs fully implemented;**
3035 (17060201SL034_04)	**Yankee Fork**	**Jordan Creek to Salmon River**	**9.00**	**Sediment, Habitat Alteration**	**No TMDL, Source of Impairment is Habitat Alteration**

Total Maximum Daily Load (TMDL) Upper Salmon River Watershed Hydrologic Unit Code 17060201 January 2002 – continued					
Water Quality Limited Segment **(Assessment Units)**	**Stream Name**	**303(d) Listed** *Reach*	*Miles*	**Pollutant**	**Subbasin Assessment Recommendation**
3036 **(17060201SL032_04)**	**Yankee Fork**	**4th of July Creek to Jordan Creek**	**2.92**	**Sediment, Habitat Alteration**	**No TMDL, Source of Impairment is Habitat Alteration**
5226 **(17050201Sl081_02a)**	**Lost Creek**	**Headwaters to Sink**	**4.45**	***Unknown***	**Remove; Listed in Error**
5227 **(17060201SL020_02)**	**Kinnikinic Creek**	**Sawmill Creek to Salmon River**	**2.99**	***Unknown***	**No TMDL, Relist in § 4b, all BMPs fully implemented and Metals Concentration below criteria**
7009 **(17060201SL124_04 17060201SL125_02 17060201SL125_03)**	**Road Creek**	**Headwaters to E.F. Salmon River**	**15.77**	***Unknown***	**List for Flow Alteration below lower BLM boundary**
3029; 3030 **(17060201SL021_04)**	**Squaw Creek**	**Headwaters to Mouth**	**8.28**	***Temperature***	**No TMDL, Geothermal Influence**

- ***Beneficial Uses Affected: Salmonid Spawning and Coldwater Biota***
- Key Resources: Chinook Salmon, Sockeye Salmon, Steelhead Trout, Bull Trout, Westslope Cutthroat Trout
- ***Pollutant Sources: Nonpoint source sediment from streambank erosion and Roads,***

About This Document

The Upper Salmon River Subbasin Assessment and TMDL is the last document that will be written without a template that is intended to standardize TMDLs written by the Idaho Department of Environmental Quality. The structure of this document is a hybrid of sorts that has been used in several previous subbasin assessment/TMDL packages with success. The intent of this structure is to start at the watershed scale and work inward toward specific waters that have been placed on the §303(d) list.

After general discussions about geology, climate, hydrology, topography etc., each sub-watershed is described with regard to historic use, where historic data was available and fluvial morphology is discussed, in general terms. The Water Quality Concerns and Status section provides a review of applicable water quality standards and then develops the available data on particular streams on the §303(d) list. The disposition of each stream is described with regard to its beneficial use support status, any changes in §303(d) listing, and why or why not a TMDL is being prepared for the Stream.

The last part of the Water Quality Concerns and Status section includes assessments by other agencies, directed data regarding abandoned mined, NPDES outfalls, data gaps, a pollutant source inventory, and a summary of pollution control efforts and a summary of findings for each §303(d) listed stream.

The Challis Creek TMDL follows, which is the only TMDL developed in this document. Readers not wanting to go through all of the sections can get a succinct overview of the findings and direction of this document by reading the Watershed at a Glance, Executive Summary, and Water Quality Status Summary on Page 75.

Comments received during the public comment period are included after the TMDL along with the response to comments. This section is followed by references, a glossary of terms and appendices.

The implementation plan for best management practices that will be developed on Challis Creek is due within 18 months of the approval of the TMDL by EPA. There are numerous implementation projects already underway in this watershed as a result of efforts to restore anadramous fish species.

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CHARATERIZATION OF THE WATERSHED

The Upper Salmon River subbasin (from here on referred to as the "Upper Salmon" subbasin) is located in the central Idaho mountains (Figure 1). This subbasin, identified in the USGS Hydrologic Unit Code nomenclature system, a system to group surface waters, as HUC #17060201, contains 2,425 square miles of land area with 5,711 miles of stream. The northern boundary of the subbasin is bordered by the Frank Church River of No Return Wilderness. The western extent is bordered by the Sawtooth Mountains. To the south are the Boulder Mountains and Galena Summit, where the headwaters of the Salmon River originate. The Eastern boundary runs along the Pahsimeroi Mountains of the Lost River Range. Up through the center of the subbasin run the Boulder-White Cloud Mountains. This mountainous terrain has produced many steep-valley stream systems and glacial lakes and troughs that feed the headwaters of the Salmon River.

Climate

The climate of the Upper Salmon Subbasin is primarily influenced by Pacific Maritime air masses moving eastward over the area on prevailing westerly winds (BLM, 1998). Cold winters and warm dry summers characterize the area. Influences in elevation, climate, and aspect of the area cause climate conditions to be variable throughout the subbasin.

The maximum summer temperatures within the subbasin can exceed 100° F with a minimum winter temperature dropping below 0°F (BLM, 1998). The average maximum monthly temperatures for the subbasin range from 78° F in Stanley to 85° F in Challis (Idaho Climate Summaries, 2000). The average monthly minimum for the Upper Salmon subbasin range from 6° F in Stanley to 9° F in Challis.

Extremely high and low temperatures occur nearly every year but only persist for a short period (BLM, 1998). Daily freezing and thawing occur during the late fall and early spring months. The frost free growing season lasts for less than 100 days in the lower elevations and may be as few as 10 days in the higher elevations of the subbasin. During the winter months, extended durations of extremely cold temperatures may cause water bodies to ice over. Ice build up within the streams and rivers of the region can cause flooding or severe bank damage as the ice breaks away from the banks.

Approximately 70% of the precipitation falls within the spring and fall seasons (DEQ, 1998). The wettest months occur during April, May, and June, with the driest months occurring during January through March (BLM, 1998). The average annual precipitation ranges from 14.54 inches in Stanley to 7.4 inches in Challis (Idaho Climate Summaries, 2000). Snow depths within the subbasin vary considerably with greater amount of accumulation occurring at the higher elevations. The average annual snowfall ranges from 72.4 inches in Stanley to 15.7 inches in Challis.

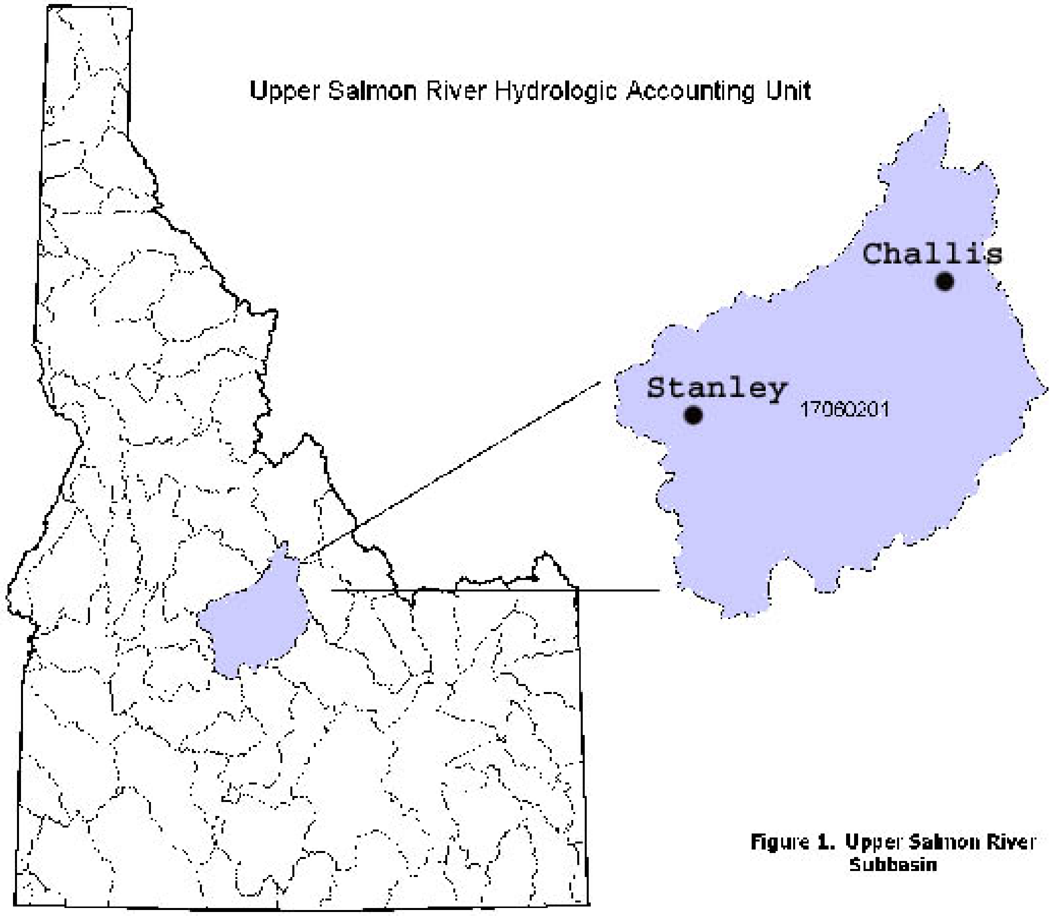

Figure 1. Upper Salmon River Subbasin

Diverse snowmelt patterns within the subbasin may cause significant runoff events in early spring through the summer. Snowmelt in the lower reaches of the subbasin begins in early spring while snowmelt in the higher elevations occurs in early to mid-summer. The greater snow pack in the higher elevations results in larger streamflow discharge in mid to late summer. Rain on snow events that occur in the spring season also contribute to the increased stream flows.

Thunderstorms occurring in late spring and summer may also vary precipitation patterns throughout the subbasin. In some instances, precipitation from the high intensity storms can cause flash flooding and subsequent erosion damage within a stream system.

Geology

The geology of the Upper Salmon Subbasin is variable across the subbasin. A basic map of the Upper Salmon River Subbasin geology that groups course unconsolidated alluvial deposits with glacial deposits under alluvium is found in the Idaho Department of Water Resources base coverage found in Figure 2. The oldest rocks underlying the majority of the subbasin include the Precambrian Basement complex. It is comprised of 1.5 billion year old gneiss and schist, metamorphosed from much older rock under intense heat and pressure (Maley, 1987).

Sedimentary rocks formed during the Paleozoic Era about 500 to 600 million years ago were deposited on top of Precambrian formations and are found in eroded or exposed areas throughout the subbasin (USDA FS, 1997a). During the Paleozoic Era, large parts of Idaho were submerged under shallow seawater for long intervals (USDA FS, 1997b). Rocks that formed include limestone and argillite, a hardened or consolidated mudstone or shale.

Another rock type found in the Upper Salmon subbasin is the Challis Volcanics. The Challis Volcanics include a series of widespread lava eruptions beginning about 51 million years ago, followed by violent rhyolitic ash-flow eruptions from caldera complexes starting about 48 m.y. ago. The volcanics overlie much of the Precambrian and Paleozoic complexes within the subbasin, and erupted from various calderas north and west of (and including) the Twin Peaks Caldera. In some areas, these rocks are interbedded with Paleozoic sediments generated from the paleozoic formations that eroded between the series of volcanic flows.

Paleozoic complexes and minor Challis Volcanics dominate the Pahsimeroi Moiuntains of the Lost River Range along the eastern border of the subbasin. The Lost River Range is part of the Basin and Range Province formed by faulting that has occurred over the last million years. The Basin and Range Province is characterized by linear mountain ranges separated by flat valleys. This area has active ground movements such as the 1982 Challis earthquake, which moved the valley floor and the Lost River Range further apart.

Along the south and western portion of the subbasin are the Boulder, White Clouds, and Sawtooth Mountain Ranges. These ranges are comprised of metamorphic rock originating from the Idaho batholith granitics and the younger Sawtooth batholith. The fine-grained gray colored granites originate from the Idaho Batholith and the pink granites with larger crystals come from the Sawtooth batholith complex. Much like the Lost River Range, the Sawtooths were formed from faulting creating the Stanley Basin and Sawtooth range. The rugged appearance of the Sawtooth Range on the west side of the subbasin was formed by alpine glaciation. The granite forming the Sawtooth batholith has well developed jointing, causing the distinctive ragged topography.

The major sediment sources in the subbasin include granitics from the Idaho and Sawtooth batholith, Challis Volcanics, lakebed sediments deposited in the lower part of the subbasin and glacial till deposited in the upper subbasin, particularly the Stanley Basin (USDA FS/BLM, 1998). The erosional processes of these soils are variable. Granitics soils from the batholith are susceptible to sheet, gully, and rill erosion processes. Soils formed from the Challis Volcanics are more susceptible to compaction and is slick when wet (from clay) making them sensitive to erosion. Soils containing ash from the Challis Volcanics have weathered to clay and have a high water holding capacity. In some cases, mudflows or landslides may occur when clay soils reach saturation. An example of this occurring is the 1998 debris flow in Slate Creek. Soils formed from glacial till have a high sediment content and are also easily erodable.

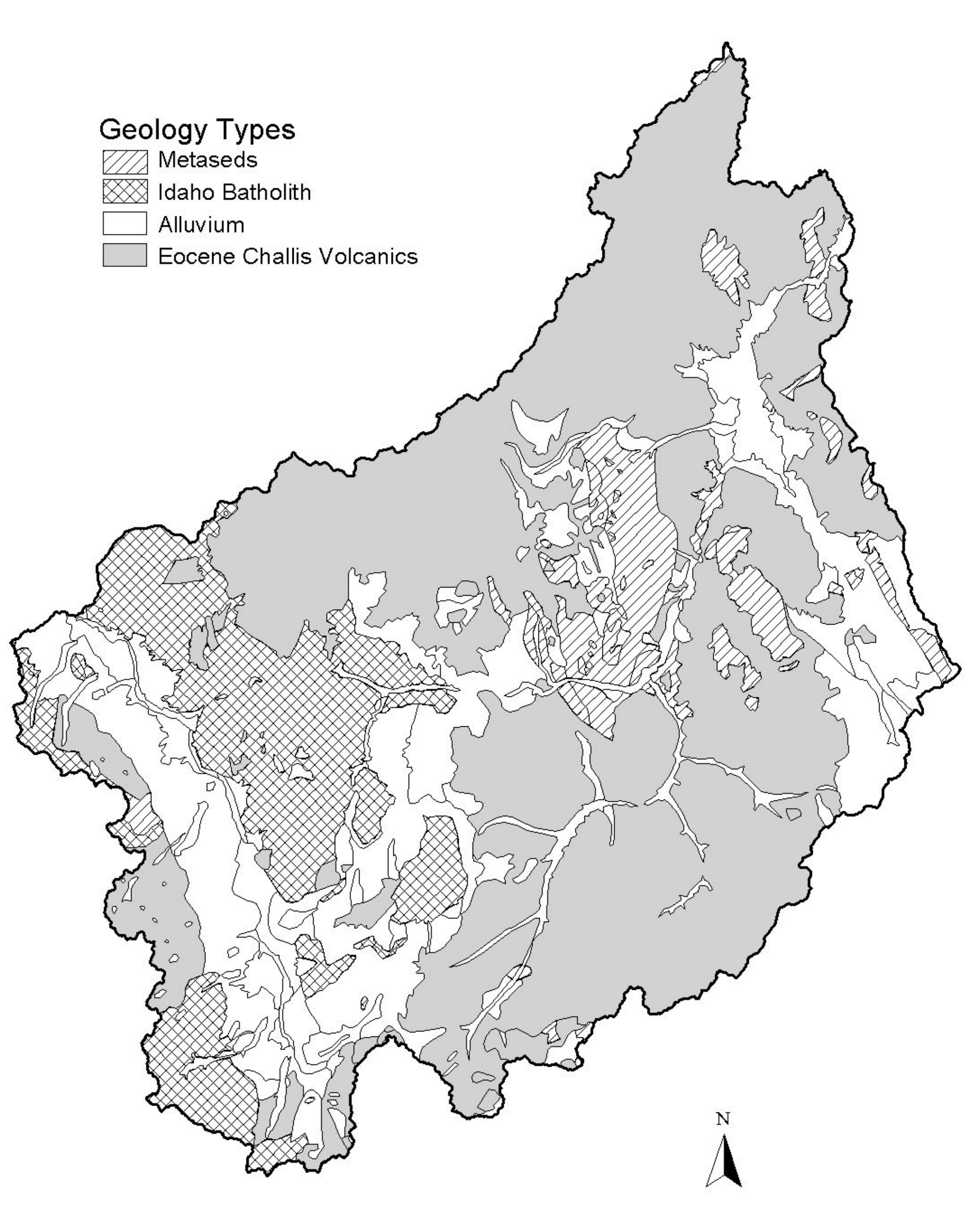

Figure 2. Upper Salmon River Subbasin Geology.

Topography

The Upper Salmon subbasin is a glacially carved mountain and valley system. The major mountain ranges of the subbasin are the Sawtooth, Boulder White Cloud, and Lost River Mountain Ranges. The White Cloud Mountain Range is in the interior of the subbasin with the other ranges bordering the edges of the subbasin. The highest elevations are found in the Boulder Mountain Range (e.g. Galena Peak, 11,170 feet).

The general relief of the area varies from nearly flat on the valley floors of the major drainages, to nearly vertical cliffs on the mountain faces and cirque walls (BLM, 1998). The Salmon River, the major drainage of the subbasin, flows through narrow V-shaped valleys flanked by cliffs, rock outcrop, and moderate to very steep terrain as well as intermittent open valleys near it's headwaters and the lower part of the subbasin. Glacial, fluvial, and alluvial deposits form the bottoms of the stream valleys.

The glaciers that occurred throughout the area also influenced the Sawtooth topography of the area. Glaciers came down the valleys of the subbasin gouging out deep valleys of the area just above the Basin bottom. Mountain lakes in the region, such as Alturas, Stanley, Petit, and Redfish Lakes are remnants of the glaciation.

The general aspect of the subbasin varies. The north facing slopes tend to be colder and wetter and retain snow longer. The south facing slopes are warmer and drier and have less vegetation.

Vegetation

The dominant forest vegetation includes lodgepole pine/subalpine fir mix (USDA FS/BLM, 1998). At higher elevations whitebark pine becomes locally abundant. Other conifers include limber pine and Engelmann Spruce (BLM, 1998). At low elevations, lodgepole pine gives way to almost pure stands of Douglas fir on northerly aspects (BLM, 1998). Low elevation woodlands include Rocky Mountain juniper, limber pine, quaking aspen, and black cottonwoods (BLM, 1998).

The non-forest vegetation can be divided into two shrub/grass types: a dry shrub/bunchgrass type dominated by Wyoming big sagebrush and bluebunch wheatgrass, and a low shrub type dominated by low sagebrush and black sagebrush. Other species of importance include bitterbrush, curl-leaved mountain mahogany, arrowleaf balsamroot, and Idaho fescue (BLM, 1998).

Historically, riparian vegetation and woodlands included aspens, alders, willows, and abundant herbaceous vegetation (e.g. sedges). However, their extent is much reduced and is now Commonly dominated by exotic species and noxious weeds (USDA FS/BLM, 1998).

Land Ownership and Use

The majority of the Upper Salmon Subbasin is publicly owned (Figure 3). The Public lands are shared by the Sawtooth National Recreation Area (35%), the Salmon-Challis National Forest (34%), the Bureau of Land Management (BLM) Challis Resource Area (24%), and the State of Idaho (2%). Private ownership occupies 5% of the land area and is generally concentrated around the City of Challis and along the Salmon River, especially near Stanley.

The largest city within the subbasin is Challis, with a population of 1,072 (Idaho Department of Commerce, 2000). Smaller towns include Stanley and Clayton. The majority of the subbasin is

included within Custer County (population: 4,107 people) (Idaho Department of Commerce, 2000). Custer County includes area outside the subbasin such as the Middle Fork Salmon River, Pahsimeroi River Subbasin and the Big and Little Lost River Subbasins. On average, Custer County has had virtually no increase in population from 1990 to 1998.

Land use for the subbasin is depicted in Figure 4. The dominant uses of public lands within the subbasin are livestock grazing, mining, and recreation. Mining is very important to the economy of the Upper Salmon subbasin. Nationally, 0.45% of the mining occurs within this subbasin (USDA FS/BLM, 1998). Many of the Upper Salmon River Subbasin watersheds have experienced mining activities in the past, with some still on-going today. Historically, hydraulic and placer mining were widely used succeeded by shaft and adit mines. The largest active mine of the region is the Thompson Creek Molybdenum Mine located within the Thompson Creek and Squaw Creek watersheds. The Grouse Creek Gold Mine, located in the Jordan Creek watershed, went into closure in 1997, but at this time does not have a remediation plan. Jordan Creek is a tributary to the Yankee Fork of the Salmon River. Potential exists for future mining opportunities throughout the subbasin.

Livestock grazing includes sheep, cattle and horses, is widespread throughout the subbasin, and has been a constant land use for over a century. The subbasin lowlands are primarily used for grazing and feed production with a few upper rangeland areas grazed by sheep. The Challis Creek area, for example, has been grazed heavily by sheep, cattle and horses from the late 1800's. Regulated grazing began in 1906 in that watershed, in that fees were charged and permits were issued. Grazing remained at high intensity until 1950, when grazing management began to improve with issuance of permits for specific allotments (USDA FS 1997b). The majority of grazing allotments within the subbasin are managed under an Allotment Management Plan administered by the BLM and USDA Forest Service (BLM, 1998). Livestock grazing and irrigated cut hay pasture are the dominant activities on private land, although residential development is increasing substantially.

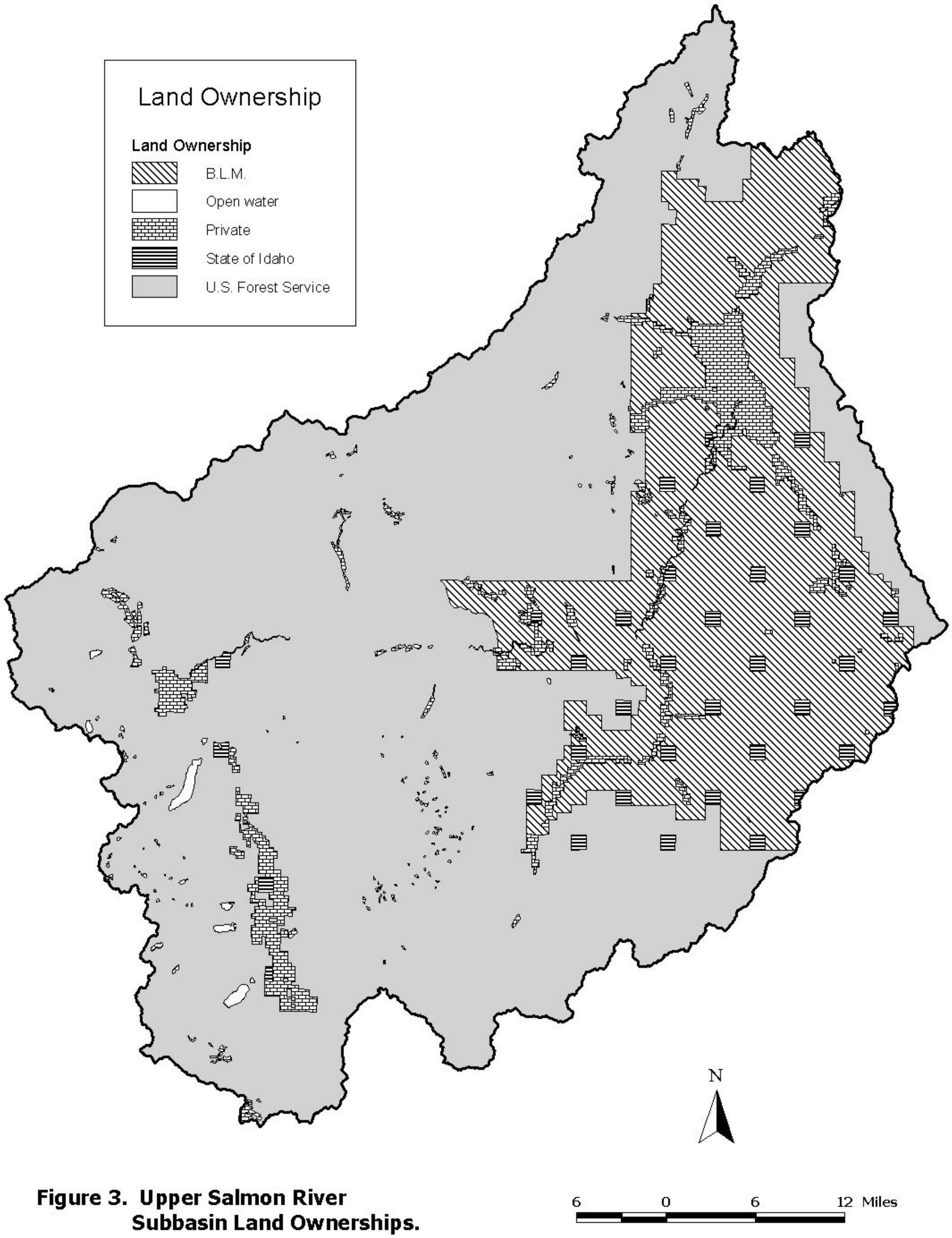

Figure 3. Upper Salmon River Subbasin Land Ownerships.

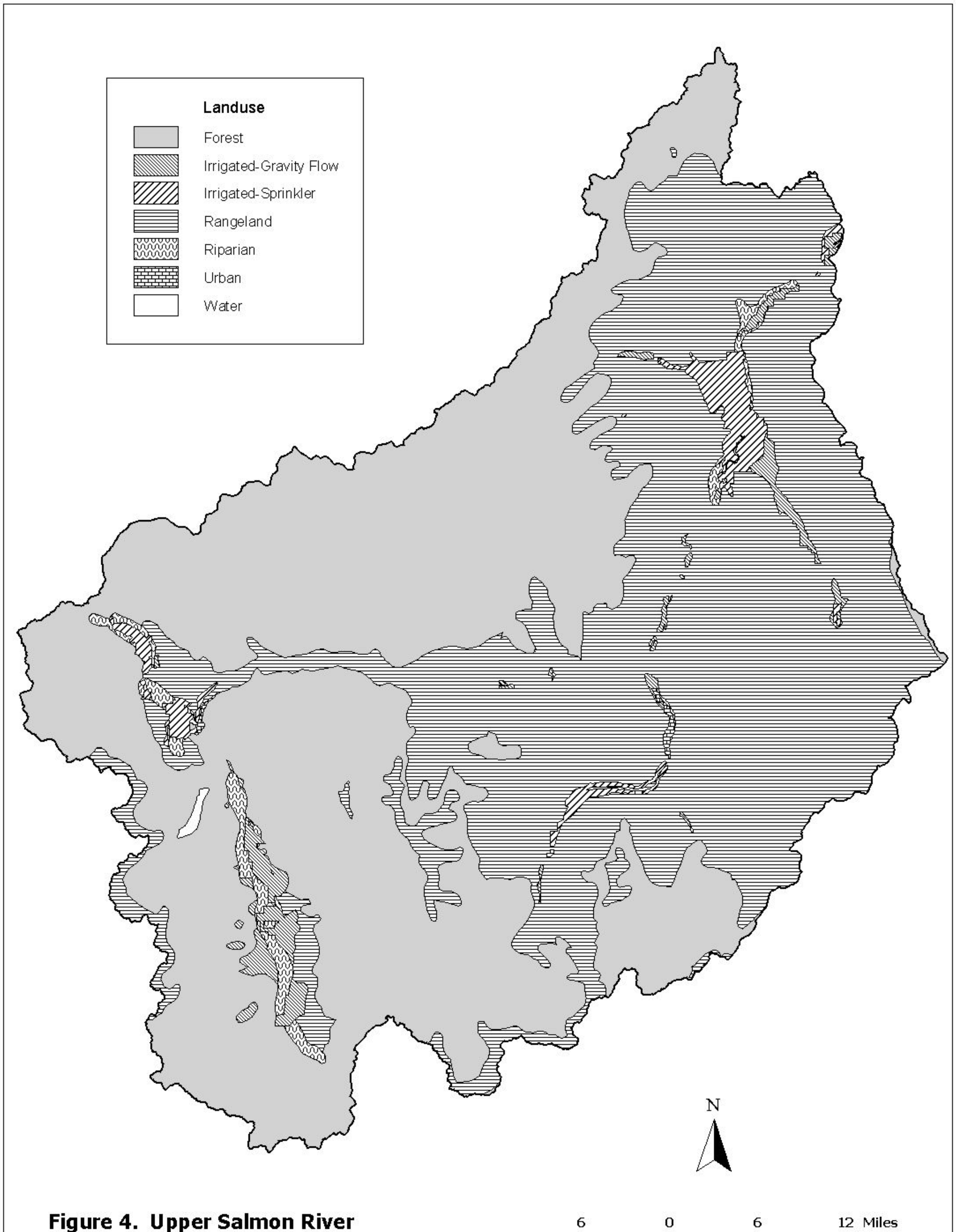

Figure 4. Upper Salmon River Subbasin Landuses.

Recreational opportunities have become increasingly popular in the subbasin. A significant source of employment for the town of Stanley, near the headwaters of the Salmon River, is based in the hospitality industry, which is strongly related to recreation. The US Forest Service administers the Sawtooth National Recreation Area (SNRA). Recreational uses in the area include fishing, hunting, hiking, horse back riding, camping, backpacking, mountain biking, rock climbing, all terrain vehicle use, and river rafting. Competition for limited recreational resources between different uses within this subbasin is also increasing.

Hydrology

The Upper Salmon Subbasin is within the Columbia River Basin hydrologic region. The principle drainage of the subbasin is the Salmon River from its headwaters to the confluence with the Pahsimeroi River. There are 65 major streams within the subbasin (Figure 5) consisting of 5,711 miles of streams (USDA FS/BLM, 1998). The drainage area is approximately 2,425 square miles. Stream flow regimes are typical of central Idaho mountain streams with seasonal peak flows in late spring to early summer from snowmelt runoff. Summer thunderstorms are the usual supply for daily peak flows. Low flow occurs in late summer through the winter. There is substantial variability from year to year due to fluctuating precipitation and temperatures.

The Upper Salmon Subbasin is primarily composed of steep, narrow drainages with V-shaped valleys. The floodplain of the Upper Salmon River, in the Stanley Basin, is fairly broad compared to floodplain in the canyon reach of the Salmon River further downstream. Irrigated agriculture exists on the river's floodplain throughout the lower reaches of the subbasin below the canyon.

The East Fork of the Salmon River is the largest tributary to the Salmon River within the Upper Salmon River subbasin. The lower portions of the East Fork Salmon River have gradients less than 1% with an average channel width between 40 to 60 feet. Many tributaries to the Salmon River in the subbasin are relatively small with steep gradients.

Several gaging stations were located throughout the subbasin, but only two remain active during the high flow season (Table 1). These are located at Thompson Creek above the Salmon River confluence and on the Salmon River below the Yankee Fork confluence. The average annual flow of the Salmon River within the subbasin varies from 81 cubic feet per second (cfs) at Obsidian to 987 cfs near Clayton. Near the mouth of the subbasin, average annual flows may increase to approximately 1500 cfs. Average annual flow for the Salmon River near Salmon, about 40 miles downstream from the subbasin, is 1941 cfs.

Table 1. Salmon River average annual flow data.

Station Name	Source or Station #	Data Years	Ave. Annual Flow (CFS)	Minimum Ave. Flow (CFS)	Maximum Ave. Flow (CFS)
Salmon River at Obsidian	(USDA FS/ BLM, 1998)	unknown	81	55	128
Salmon River below Valley Cr.	(USDA FS/ BLM, 1998)	unknown	664	410	1020
Salmon River below Yankee Fork	(USDA FS/ BLM, 1998)	unknown	995	466	1640
Salmon River near Clayton	13296500 (USGS)	1921-1991 (high flow) 1991-present	987	315	2800
Salmon River near Bayhorse Creek	(USDA FS/ BLM, 1998)	unknown	1490	855	2470
Salmon River above Pahsimeroi River (estimated)	(USDA FS/ BLM, 1998)	unknown	1595	935	2600
Salmon River near Salmon	13302500 (USGS)	1913-1916, 1919-1996	1941	328	17400

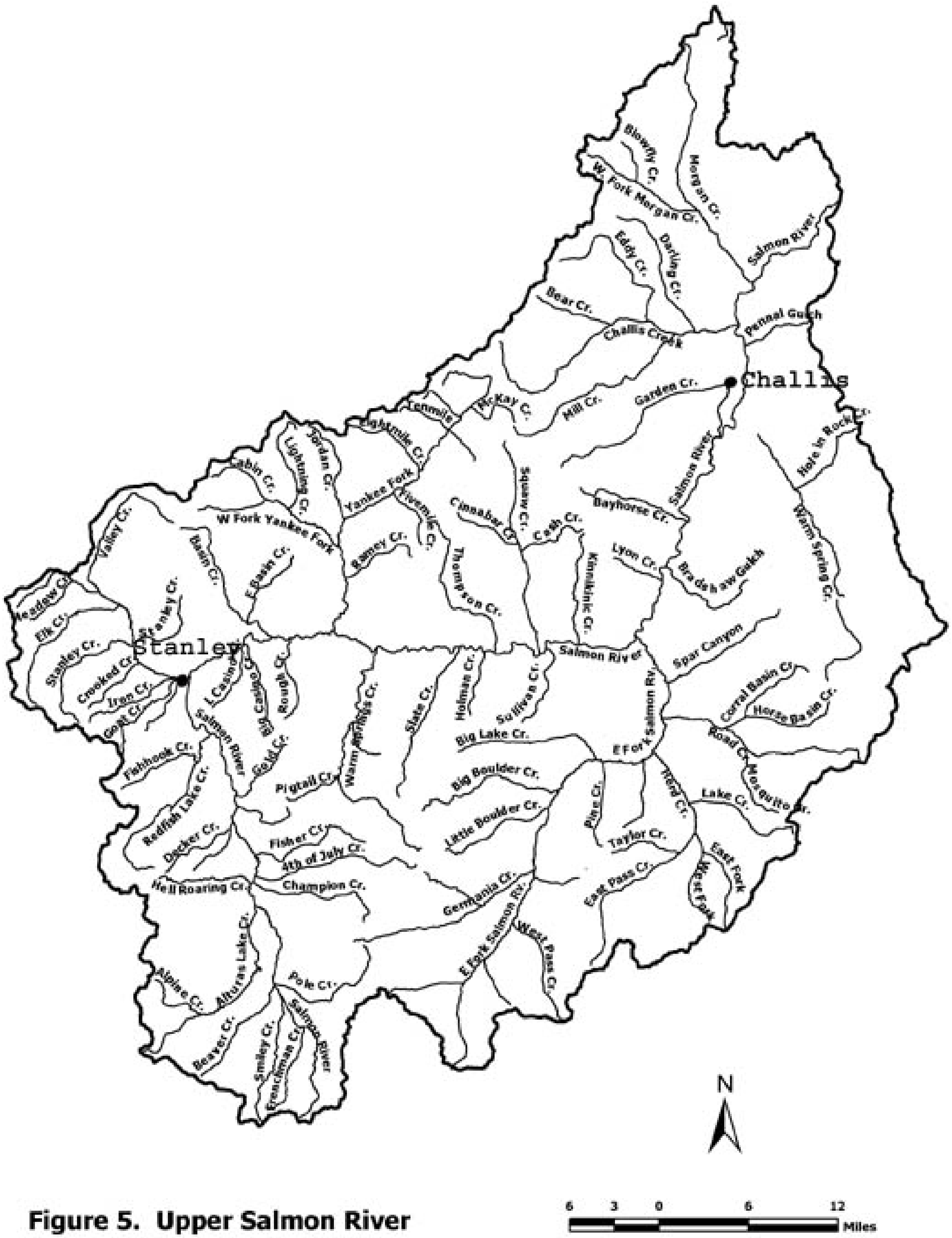

Figure 5. Upper Salmon River Subbasin Major Streams.

Natural stream channel types within the subbasin are generally classified as Rosgen A-, B-, and C-type channels. Rosgen A-type channels are referred to as sediment source channels and have high relief and are entrenched in steep mountain terrain. This type channel has a low width to depth ratio and low sinuosity, with vertical pools and high debris flow potential. Many of these streams are intermittent and support little riparian vegetation.

Rosgen B-type channels are sediment transport channels and are most common throughout the subbasin. These channels have a moderate: gradient, sinuosity, width to depth ratio and entrenchment ratio. They occur in narrow, moderately sloping valleys and are dominated by riffles with occasional pools. Rosgen B-type channels usually have stable bottom material and are more dependant on riparian vegetation and large woody debris for stability.

Rosgen C-type channels, also called sediment response reaches (sediment depositional), are low gradient channels located in gently sloping valleys with floodplains and terraces. Rosgen C-type channels are meandering and slightly entrenched with moderate width to depth ratios. These channels tend to meander, but under natural conditions do so at a rate that allows for streambank stability over 80% (by definition a stable streambank is associated with a stream that can handle it's sediment load (David Rosgen 2001, personal communication)). These reaches tend to have high aquatic and riparian species diversity. This is where the greatest amount of human use also occurs.

Surface water quality varies throughout the subbasin and is dependant on land uses, local geology, and discharge. Most surface water originates in the high mountainous areas above the principle drainage and is of high quality near the source. Water quality in the lower reaches tends to become more degraded. Water quality degradation occurs as sediments and other pollutants are deposited into the stream. Primary sediment pollutant sources within the Upper Salmon subbasin are excessive streambank erosion, road runoff, mine tailings and waste rock, agriculture practices, and runoff from developed areas. Natural sediment sources include hill slope erosion, streambank erosion, occasional mass wasting of steep slopes and products of weathering carried by runoff. Surface waters are also affected by irrigation impoundment, and diversion structures at lower elevation reaches, precluding, in some cases, flow from reaching the mainstem Salmon River.

Fish

The Upper Salmon subbasin is generally characterized by its clear, cool mountain streams. Most streams historically contained a number of native salmonids, including bull trout, westslope cutthroat trout, resident rainbow trout, mountain whitefish, Chinook salmon, and steelhead trout . The subbasin contains spawning and rearing waters for anadromous fish, including steelhead trout, Chinook salmon, and sockeye salmon, and represents the second longest migration route in North America (USDA FS/BLM, 1998). The subbasin also contains the sole remaining population of anadromous sockeye within the Snake River Basin (USDA FS/BLM, 1998). Chinook salmon and steelhead trout are listed as threatened species under the Endangered Species Act. Sockeye are listed as endangered under the Endangered Species Act. Critical habitats for sockeye salmon designated in 1993 include five lakes (Redfish, Alturas, Stanley, Pettit, and Yellowbelly) in the Sawtooth National Recreation Area (SNRA) and all their connecting tributaries including the mainstem Salmon River. Stocking of sockeye has been taking place in Redfish, Alturas, and Pettit Lakes as a part of recovery efforts since 1993 (DEQ, 1999a).

The Upper Salmon subbasin supports some of the most important spawning and rearing habitats for the Snake River spring/summer Chinook salmon, although current stocks are severely depressed compared to historic levels (USDA FS/BLM, 1998). Chinook spawn in all sizes of rivers and streams in the subbasin, thus, most streams are designated critical habitat (DEQ, 1999a). Adult chinook arrive in May and June and spawn from August to October.

The central Idaho mountains are core habitat areas for remaining bull trout populations. Bull trout distribution tends to be patchy even when population numbers are strong and habitat is good (USDA FS/BLM, 1998). Bull trout generally spawn in mid to late September through October in the Salmon River basin (DEQ, 1999a). In the SNRA and Salmon-Challis NF, they spawn in early September, or in some cases, early to mid August at the highest elevations. Threats to bull trout in this subbasin include channelization, diking, riprap, loss of stream-side vegetation, and changes in channel dynamics such as flood plain access in low elevation reaches.

Similar issues threaten westslope cutthroat trout, although populations may be a little more widespread, especially in wilderness/roadless areas. Cutthroat trout are now primarily found in small headwater streams (DEQ, 1999a). The larger migratory form of cutthroat is essentially extinct from the subbasin (DEQ, 1999a). The last large cutthroat trout were seen in the 1920s and 1930s in the Stanley area. The last migratory population in Valley Creek disappeared in the 1940s. The East Fork Salmon River had a few migrating cutthroat until the 1980s.

Hatchery cutthroat trout are being stocked into mountain lakes in the subbasin, and an intensive re-introduction of cutthroat and bull trout is taking place in Valley Creek (DEQ, 1999a).

The Salmon River in general is considered a core area for remaining stocks of wild steelhead trout. Rainbow trout are the most widely distributed native salmonid (DEQ, 1999a). Many surveys tend not to separate young steelhead from resident rainbows, although it is likely that most rainbow trout surveyed are likely residents, potentially isolated by irrigation diversion structures.

Many of these salmonids have experienced declines in habitat, abundance, and life histories during the last century (USDA FS/BLM, 1998). The decline in the anadromous species has been the greatest. Within the subbasin, problems include habitat degradation and stream flow alteration and diversion in the lower watersheds that prevent migration and the introductions of non-native salmonids especially brook trout. Outside of the basin anadromous fish are severely impacted by hydroelectric dams. Dams on the Lower Snake River and Columbia River create migration barriers and slack water that limit fish passage to and from the ocean and estuaries.

Introductions of non-native fish into the subbasin include sunapee char, arctic grayling, golden trout, lake trout, brook trout and non-indigenous rainbow trout. These fish have been introduced into high mountain lakes, lowland lakes, rivers and streams (USDA FS/BLM, 1998). Brook trout are widely distributed and are found in many tributaries within the subbasin (DEQ, 1999a). In this subbasin, brook trout prefer small tributaries and are not found in the mainstem Salmon River. Brook trout tend to dominate the lower elevation reaches and native trout stay in higher elevation reaches. In 1995, Valley Creek fish surveys produced high percentages of brook trout. Also, some mountain lake systems (lakes and inlet/outlet streams) are dominated by brook trout.

Recent sampling associated with DEQ's large river Beneficial Use Reconnaissance Project (BURP), monitoring of aquatic life in Idaho's streams, resulted in collection of multiple age classes of salmonids as well as several sculpin and dace species, largescale sucker, chiselmouth, northern pikeminnow, and redside shiner (Table 2).

Table 2. Large river BURP fish collections in 1999.

Location	Fish Collected	Age Classes
Salmon River near Obsidian (passes 1 and 2 combined)	19 brook trout, 10 cutthroat trout, 18 shorthead sculpin,	Trout ages = 4 Salmonid ages = 4 Sculpin ages = 4
Salmon River at Yankee Fork near Clayton	8 chinook, 40 mountain whitefish, 3 rainbow trout, 2 mottled sculpins, 62 shorthead sculpin, 3 longnose dace	Trout ages = 2 Salmonid ages = 6 Sculpin ages = 5
Salmon River at Pahsimeroi River near Challis	16 chinook, 73 mountain whitefish, 6 rainbow trout, 53 mottled sculpin, 2 shorthead sculpin, 25 largescale sucker, 1 chiselmouth, 2 longnose dace, 1 northern pikeminnow, 8 redside shiner, 8 speckled dace	Trout ages = 3 Salmonid ages = 6 Sculpin ages = 4

Other native fish include the Pacific lamprey, once abundant where anadromous host fish resided (DEQ, 1999a). The presence of white sturgeon in the Salmon River is documented as recent as 1996 by the Salmon-Challis NF.

SUB-WATERSHED DESCRIPTIONS

The sub-watershed boundaries used in this subbasin assessment are those depicted in Figure 6. Sub-watershed descriptions are based on descriptions of drainages provided by various resource agencies and documents. Often sub-watershed boundaries differ from agency to agency and from document to document. Thus, data are often less than precise when different boundary conventions can affect various measurements such as area estimates. These descriptions lay the foundation for discussions of specific water quality concerns and water quality-limited waters in the next section and are intended to be introductions to specific watersheds within the subbasin.